Boxelder Creek

## SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 52311263 Date 9/17/10 Initials CMW Region (A B C D)

Site _____ Location Approx 1.4mi NW from intersection Nimo Rd & Norris Peak Rd

$Q_{100}$ = 3160 by: drainage area ratio ✓ flood freq. anal. ____ regional regression eq. ____

Bridge discharge ($Q_2$) = 3160 (should be $Q_{100}$ unless there is a relief bridge, road overflow, or bridge overtopping)

### Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

PGRM: "RegionA", "RegionB", "RegionC", or "RegionD"

Bridge Width = 108 ft. Flow angle at bridge = 0 ° Abut. Skew = 10 ° Effective Skew = ~10 ? ° Used 10°

Width ($W_2$) iteration = 100 78 86 79

Avg. flow depth at bridge, $y_2$ iteration = 4.8 5.5 5.2 5.5

Corrected channel width at bridge Section = $W_2$ times cos of flow angle = 77.8 ft* $q_2 = Q_2/W_2$ = 40.6 $ft^2/s$

Bridge Vel, $V_2$ = 7.4 ft/s Final $y_2 = q_2/V_2$ = 5.5 ft $\Delta h$ = 1.1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 6.6 ft

** NOTE: repeat above calculations until $y_2$ changes by less than 0.2* *Effective pier width = L sin(q) + a cos(q)*

*If $y_2$ is above LS, then account for Road Overflow using PRGM: RDOVREGA, RDOVREGB, RDOVREGC, or RDOVREGD.*

Water Surface Elev. = _____ ft

Low Steel Elev. = 10.2 ft

n (Channel) = 0.035

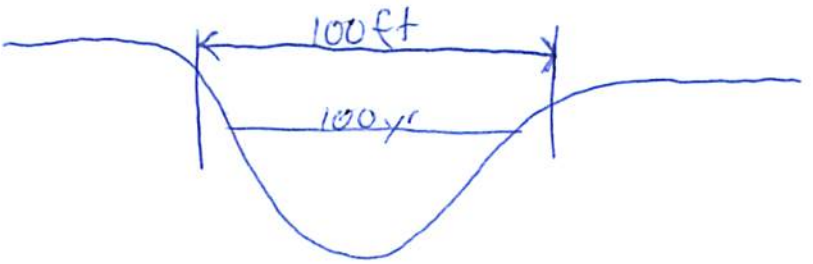
n (LOB) = 0.040

n (ROB) = 0.033

Pier Width = 0.90 ft

Pier Length = 1.35 ft

# Piers for 100 yr = 2 ft




### CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section $W_1$ = 100 ft

Width of left overbank flow at approach, $W_{lob}$ = 0 ft Average left overbank flow depth, $y_{lob}$ = 0 ft

Width of right overbank flow at approach, $W_{rob}$ = 0 ft Average right overbank flow depth, $y_{rob}$ = 0 ft

Live Bed Contraction Scour (use if bed material is small cobbles or finer)

$x$ = _____ From Figure 9 $W_2$ (effective) = _____ ft $y_{cs}$ = _____ ft

PGRM: CWCSNEW

Clear Water Contraction Scour (use if bed material is larger than small cobbles) ~~2 = 3.1667 4.129~~ 0

Estimated bed material $D_{50}$ = 0.20 ft Average approach velocity, $V_1 = Q_{100}/(y_1 W_1)$ = 4.79 ft/s

Critical approach velocity, $Vc = 11.52 y_1^{1/6} D_{50}^{1/3}$ = 4.95 ft/s

If $V_1 < V_c$ and $D_{50} >= 0.2$ ft, use clear water equation below, otherwise use live bed scour equation above.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = 0.05437 ft If $D_{50} >= D_{c50}$, $\chi = 0.0$

Otherwise, $\chi = 0.122 y_1 [q_2/(D_{50}^{1/3} y_1^{7/6})]^{6/7} - y_1$ = _____ From Figure 10, $y_{cs}$ = 0.0 ft

### PIER SCOUR CALCULATIONS

PGRM: Pier

L/a ratio = 1.5 Correction factor for flow angle of attack (from Table 1), K2 = 1.05

Froude # at bridge = 0.56 Using pier width a on Figure 11, $\xi$ = 4.4 Pier scour $y_{ps}$ = 4.2 ft

### ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, $y_{aLT}$ = 0 ft right abutment, $y_{aRT}$ = 0 ft

Shape coefficient $K_1$= 1.00 for vertical-wall, 0.82 for vertical-wall with wingwalls, 0.55 for spill-through

Using values for $y_{aLT}$ and $y_{aRT}$ on figure 12, $\psi_{LT}$ = 0 and $\psi_{RT}$ = 0

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 0 ft

## SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 52311263 Date 9/17/10 Initials CMW Region ( (A) B C D )

Site _____ Location Approx 1.2NW from Intersection Nemo Rd & Norris Peak Rd

$Q_{500}$ = 17400 by: drainage area ratio ✓ flood freq. anal. ____ regional regression eq. ____

Bridge discharge ($Q_2$) = 12453 (should be $Q_{500}$ unless there is a relief bridge, road overflow, or bridge overtopping)

### Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

PGRM: "RegionA", "RegionB", "RegionC", or "RegionD"

Bridge Width = 100 ft. Flow angle at bridge = 0 ° Abut. Skew = 10 ° Effective Skew = 10 °

Width ($W_2$) iteration = 100

Avg. flow depth at bridge, $y_2$ iteration = 12.3 Overflow W = 100 cos 10 = 98.48

Corrected channel width at bridge Section = $W_2$ times cos of flow angle = 98.48 ft* $q_2 = Q_2/W_2$ = 126.5 ft²/s

Bridge Vel, $V_2$ = 12.4 ft/s Final $y_2 = q_2/V_2$ = 10.2 ft $\Delta h$ = 3.2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 13.4 ft

** NOTE: repeat above calculations until $y_2$ changes by less than 0.2* *Effective pier width = L sin(q) + a cos(q)*

*If $y_2$ is above LS, then account for Road Overflow using PRGM: RDOVREGA, RDOVREGB, RDOVREGC, or RDOVREGD,*

Water Surface Elev. = _____ ft

Low Steel Elev. = 10.2 ft

n (Channel) = 0.035

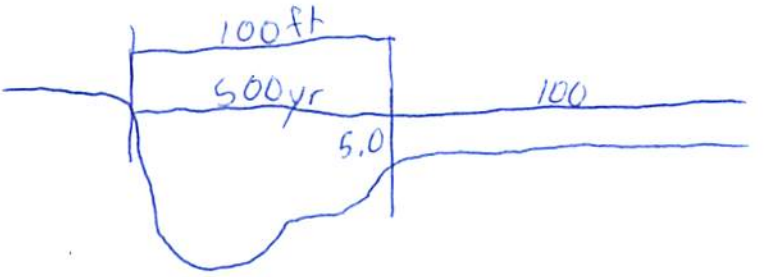
n (LOB) = 0.040

n (ROB) = 0.033

Pier Width = 0.90 ft

Pier Length = 1.350 ft

# Piers for 500 yr = 2 ft




### CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section $W_1$ = 100 ft

Width of left overbank flow at approach, $W_{lob}$ = 0 ft Average left overbank flow depth, $y_{lob}$ = 0.0 ft

Width of right overbank flow at approach, $W_{rob}$ = 100 ft Average right overbank flow depth, $y_{rob}$ = 5.0 ft

Live Bed Contraction Scour (use if bed material is small cobbles or finer)

$x$ = _____ From Figure 9 $W_2$ (effective) = _____ ft $y_{cs}$ = _____ ft

PGRM: CWCSNEW

Clear Water Contraction Scour (use if bed material is larger than small cobbles) 2 = 3.16674 0 4.65

Estimated bed material $D_{50}$ = 0.20 ft Average approach velocity, $V_1 = Q_{500}/(y_1 W_1)$ = 9.29 ft/s

Critical approach velocity, $Vc = 11.52 y_1^{1/6} D_{50}^{1/3}$ = 10.07 ft/s

If $V_1 < V_c$ and $D_{50} >= 0.2$ ft, use clear water equation below, otherwise use live bed scour equation above.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = 0.137897 ft If $D_{50} >= D_{c50}$, $\chi = 0.0$

Otherwise, $\chi = 0.122 y_1 [q_2/(D_{50}^{1/3} y_1^{7/6})]^{6/7} - y_1$ = — From Figure 10, $y_{cs}$ = 0.0 ft

### PIER SCOUR CALCULATIONS

PGRM: Pier

L/a ratio = 1.5 Correction factor for flow angle of attack (from Table 1), K2 = 1.05

Froude # at bridge = 0.68 Using pier width a on Figure 11, $\xi$ = 4.4 Pier scour $y_{ps}$ = 4.3 ft

### ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, $y_{aLT}$ = 0.0 ft right abutment, $y_{aRT}$ = 5.0 ft

Shape coefficient $K_1$= 1.00 for vertical-wall, 0.82 for vertical-wall with wingwalls, (0.55) for spill-through

Using values for $y_{aLT}$ and $y_{aRT}$ on figure 12, $\psi_{LT}$ = 0 and $\psi_{RT}$ = 15

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 15 ft

Route Nemo Rd Stream Boxelder Creek MRM _____ Date 9/17/10 Initials CMW

Bridge Structure No. 52311263 Location Approx. 1.2 NW from intersection Nemo Rd + Morris Peak Rd

GPS coordinates: N 44°08'09.9" W 163°25'46.1" taken from: USL abutment X centerline of ⇑ MRM end _____

Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 96.37 sq. mi.

The average bottom of the main channel was 15.0 ft below top of guardrail at a point 22 ft from left abutment.

Method used to determine flood flows: ___Freq. Anal. ✓ drainage area ratio ___regional regression equations.

**MISCELLANEOUS CONSIDERATIONS**

| Flows | $Q_{100}$ = 3160 | | | $Q_{500}$ = 17400 | | |
|---|---|---|---|---|---|---|
| Estimated flow passing through bridge | 3160 | | | 12453 | | |
| Estimated road overflow & overtopping | — | | | 4947 | | |
| Consideration | Yes | No | Possibly | Yes | No | Possibly |
| Chance of overtopping | | X | | X | | |
| Chance of Pressure flow | | X | | | X | |
| Armored appearance to channel | | X | | | X | |
| Lateral instability of channel | | X | | | X | |

Riprap at abutments? X Yes ____No ____Marginal

Evidence of past Scour? ____Yes X No ____Don't know

Debris Potential? X High ____Med ____Low

Does scour countermeasure(s) appear to have been designed?

| | | | | |
|---|---|---|---|---|
| Riprap | X Yes | ____No | ____Don't know | ____NA |
| Spur Dike | ____Yes | ____No | ____Don't know | X NA |
| Other _____ | ____Yes | ____No | ____Don't know | X NA |

Gabian baskets

Bed Material Classification Based on Median Particle Size ($D_{50}$)

| Material | Silt/Clay____ | Sand____ | Gravel____ | Cobbles X | Boulders____ |
|---|---|---|---|---|---|
| Size range, in mm | <0.062 | 0.062-2.00 | 2.00-64 | 64-250 | >250 |

Comments, Diagrams & orientation of digital photos

1236 - Bridge #

37 - US

38 - US RB

39 - US LB

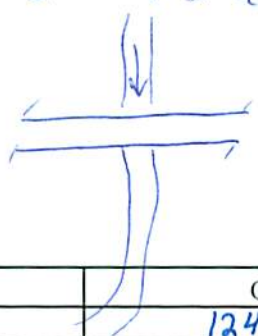
40 - R/L Abut

41 - R. Abut.

42 - US face of bridge

43 - R. Abut.

This site was a Level 2 site.



Summary of Results

| | Q100 | Q500 |
|---|---|---|
| Bridge flow evaluated | 3160 | 12453 |
| Flow depth at left abutment (yaLT), in feet | 0.0 | 0.0 |
| Flow depth at right abutment (yaRT), in feet | 0.0 | 5.0 |
| Contraction scour depth (ycs), in feet | 0.0 | 0.0 |
| Pier scour depth (yps), in feet | 4.2 | 4.3 |
| Left abutment scour depth (yas), in feet | 0.0 | 0.0 |
| Right abutment scour depth (yas), in feet | 0.0 | 15.0 |
| 1Flow angle of attack | 10° | 10° |

See Comments/Diagram for justification where required